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ABSTRACT

The role of mathematics as a critical determiner of employment is noted, and the "significant absence of women and minority students in mathematics classes" is given attention. The need to gain competence in mathematics skills and confidence in mathematical abilities calls for programs to increase student participation, motivation, and achievement. A form for collecting information on school mathematics enrollment is given, followed by a form to aid in advising students on mathematics course selection. Then research related to girls and mathematics is summarized, categorized by the three domains of socialization--perceptual, physical, and social--with special attention to peer group factors, family factors, the usefulness of mathematics, and attributional style. Suggestions for marketing mathematics courses with equity in mind are discussed, with comments on the key to marketing, price, and place. Instructional strategies for fostering girls in mathematics are presented, focusing on awareness activities, instructional climate, curriculum content, and the usefulness of mathematics role models. Ways to establish support groups for girls in mathematics, science, and computers are then listed. Finally, a checklist to assist school districts in assessing mathematics and science enrollment in terms of gender fairness is included. Recommended resources are also given. (MNS)

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The University of Michigan
School of Education
Ann Arbor

Title IX Line

Center for Sex Equity in Schools

Vol. VI, No. 1. Winter 1986

ED265071

Fostering Sex Equity in Math

FROM THE DESK OF THE DIRECTOR

Charles D. Moody, Sr.

Our sincere concern for equity in the instruction of mathematics comes from the central role that this field plays in our society in the attribution of rewards and priviledges and the bestowal of symbols of success. Areas of employment that require mathematical skills pay considerably higher wages than fields requiring comparable years of training in other types of skills. In the words of the sociologist Lucy Sells, mathematics works as a "critical filter" to select an educational elite.

Women and minority students have been significantly missing from our math classes, and thus been denied access to many relatively well-paying and prestigeous fields of work. Their attrition begins in the first years of course choices and becomes painfully obvious toward the end of high school, when presence or absence of math skills can expand or restrict employment options.

Students need to gain awareness of the importance of mathematics in our reward system. They need to gain competence in math skills and confidence in their abilities. Research shows us that the traditional math curriculum is geared to the skill needs and learning styles of white males.

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How is your Enrollment ?

Collect the information outlined in this chart and see if your school math enrollment is gender balanced.

High School Math Enrollment Data by Grade

School _____ Researcher _____

Grades	General math (basic skills, consumer math, business math)	Algebra I (first year algebra even if more than 2 semesters)	Geometry	Algebra II (2nd year algebra with or without trigonometry)	Trigonometry (advanced math: analytical geometry, pre-calculus)	Calculus	Totals
9 # Females Enrolled							
# Females in 9th Grade							
% 9th Females Enrolled							
# Males Enrolled							
# Males in 9th Grade							
% 9th Males Enrolled							
10 # Females Enrolled							
# Females in 10th Grade							
% 10th Females Enrolled							
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# Females in 12th Grade							
% 12th Females Enrolled							
# Males Enrolled							
# Males in 12th Grade							
% 12th Males Enrolled							

Advising Students on Course Selection

Student Says	You Say
But I don't like math.	Math is becoming more and more important in all areas of work.
But I don't do well in math.	Most people, even those who go into math-related careers, were not straight-A students in math.
It'll hurt my gradepoint average.	A well-rounded preparation is more important than your grade point average. Not taking math will close the door to many careers.
I don't like the teacher.	We all have our preference in teachers. If you don't understand her/his explanation, there's a study group to help you. (Make sure that there isn't harassment going on in this class.)
I'm not going to need it anyway.	The average teenager in high school today will work for over twenty years, whether male or female. You'll lose out on higher pay if you don't have a math background.
It's boring.	One of the chief reasons students find math boring is that they lack confidence in their abilities. You seem to be able to do it, now you have to convince yourself that you <u>can</u> do it.
My mother/sister/friend didn't need math.	Not everybody uses a lot of math, but more people are needing more math to do their work. You'll increase your chances of having more opportunities if you stay in math.
I feel dumb in math class.	It's awful to feel dumb. I bet you feel that way when you've run out of strategies for solving a problem. You could use a study group or some extra help. Do you have a list of problem-solving strategies that can help you keep at a tough problem?
I don't want to be a nuclear physicist or anything like that.	Do you know how much math you need to major in business? be a veterinarian? open your own store?
I'm going to get married and have babies.	Most women who are married need to work outside for financial reasons. Even if you find a millionaire, there's a good chance you'll get divorced. Besides your kids won't do well in school if you don't have faith in education.
How do you know so much? What did you take in school?	Be honest. Then point out that educators earn less than many people with technical degrees. Many educators have gone on to other careers.

Research Related to Girls and Math

Research in the area of girls and math falls within two distinct categories: research that focuses on the process of socialization and its subsequent effect on math performance, and research aimed at discerning biological gender differences related to math ability and performance. Current instruments and measurement techniques are not precise enough to accurately measure the very small biological differences that may exist. More importantly, research on biological differences is inconclusive. There is however, a plethora of research that illuminates and supports the concept that real and observable socialization processes can and do affect girls' performance in math and science.

The Three Domains of Socialization

Research examining socialization can be categorized into three major domains. The physical domain deals with the physical world and its properties. The social domain encompasses our socio-cultural existence. The perceptual domain, is the by-product of the interaction between the physical and social domains. It is more abstract than the other two, less straightforward and generally more difficult to change.

The effects of the perceptual domain are often only recognized over time, as the interactions of the physical and social domains become more integrated and pronounced within individuals. These variations become differing cognitive styles, which effect how we learn. When examining the issue of girls and math, we must explore the pervasiveness, complexity, and realities of the perceptual domain and its relation to gender, math motivation and performance.

The Perceptual Domain

Each child's perceptual orientation evolves as her or his social and physical domains interact. Usually girls are more often reinforced to interact on a social level. The intensity of this social interaction increases a girl's ability to interact with, and be familiar with the social realm. Her knowledge of social rules often becomes her primary cognitive style. If math classes ignore interactive motivation, many girls then feel uninvolved.

Within the classroom setting, teacher expectations can affect the performance and motivation of female students. Trowbridge et al., (1981) found that boys in school are "valued for thinking logically, independently, with self-confidence, and an appropriate degree of risk-taking. Girls, however, are valued for their emotional expressiveness, sensitivity to others, dependency, and subjective thinking." Research also suggests that teacher praise, in terms of math performance, is perceived differently by boys and girls. Eccles-Parsons, et al. (1982) found that, "...praise was related to (high) self-concept of ability for boys only." When efforts were made to encourage and praise boys and girls equally, boys were more likely to equate praise as positive reflections on their ability and subsequent self-concept. Girls were more likely to attribute praise to luck. They then were more likely to question their abilities as math achievers, resulting in a general lack of confidence which often affected their math course selection (Fennema and Sherman, 1977).

The Physical Domain

Developmental differences in the physical domain can also lead to disparities within the classroom. Interests and style of play for boys may help them achieve success in math and science. Boys watch more TV science shows, read more books, magazines, and newspaper articles on science, and work more with science projects and hobbies (NAEP, May 1978). Female difficulties with spatial visualization may be the result of less knowledge and experience with manipulative materials (Fennema and Sherman 1977). Skolnick, et al. (1982) also support this observation: "the factors most critical to the development of spatial visualization skills are experience with manipulative materials such as constructing and examining three-dimensional structures, graphing, and modeling." These skills are also important within the classroom, where girls demonstrate more difficulty working with science equipment and apparatus (Kahle 1983). These factors then tend to be mutually reinforcing, hampering the development of strong

spatial visualization skills and other opportunities to nurture interests related to math and science.

Peer Group Factors

Social and peer group factors within the school also mold the child's perceptions about her/his skills and desire to participate in math or science. Vockell and Lobonc (1981) found that girls enrolled in public schools selected subjects traditionally viewed as "masculine" such as calculus, chemistry, and physics less often than males, in spite of equal abilities. Enrollment patterns can even affect a girl's self-concept in relation to math and science. Skolnick, et al. (1982) observes: "Typically, a girl who wishes to pursue advanced science courses finds her fear that 'girls don't become scientists' reinforced clearly by the ratio of boys and girls in the classroom."

Family Factors

Parent expectations can play a major role in the development of a child's self-concept of math ability. Eccles, et al. (1982) found that the most dramatic differences between parents of girls, and parents of boys, were their estimates of how hard their children had to try, to do well in math. She found that parents of girls consistently perceived the effort of their daughters to be more difficult than the efforts of sons. Eccles also states, "parents of sons thought that advanced math was more important for their child than parents of daughters." Similarly, she found that, "children's attitudes were influenced more by their parents' attitudes about their abilities than by their own past performances."

Additional research by Jacobs and Eccles (1983) focused on the impact of media reports on parents' perceptions of gender differences and math ability. Exposure to media reports...(which reaffirmed the genetic difference concept) had its largest impact on mothers of daughters and fathers of sons." These reports reinforced parents' own stereotypic beliefs concerning gender and math ability. For mothers it provided a legitimizing of their own math difficulties and tacit approval of their daughters' difficulties in math. Fathers of sons stereotypical impressions were also reaffirmed toward the belief that boys are better than girls in math.

Usefulness of Math

Pedro, Wolleat, Fennema and Becker (1981) found that usefulness was second only to prior performance as a predictor of future math enrollment. Armstrong (1981) found students considered usefulness as the most important reason in deciding to continue to enroll in math classes, while Eccles (1983) found that when compared to boys, girls believed that math was of less value. Students must see the usefulness of math in order to continue studying it.

Attributional Style

Attributional style is the way individuals explain academic success or failure. A student who attributes failure to lack of skill or ability will have little reason to expect future success from the same amount of effort. Concommitantly, attributing failure to lack of effort encourages the possibility of success in the future, because it is within the control of the individual. Wolleat, Pedro, Becker, and Fennema (1980) found that males attributed their success more strongly to ability, whereas females tended to attribute their success more strongly to effort. In terms of failure, girls were more likely to attribute their shortcomings to lack of ability or difficulty of task. At all levels of achievement, females were more likely to attribute their success to effort, and as their performance level increased, the degree to which they attributed their work to effort also increased. Contrarily, as achievement increased for males, the extent to which they attributed their success to effort decreased. Similarly, Eccles (1983) found that females were more likely to attribute their successes to effort and their failures to lack of ability.

We must take the socialization research into account when we devise instructional strategies for teaching math equitably. Differences in perceptual orientation, cognitive style, and motivation are all important to understand when designing a math curriculum that will meet needs of female and male students.

- Dave Dugger

Marketing Your Math Courses With Equity In Mind

Jingles praising math on top 40 stations. Multicolored coupons to shorten homework assignments. Multiplication problems on purple banners. Famous female mathematician stickers. All of these are promotional gimmicks to inform students about math, perhaps increase their motivation to learn math, and attempt to influence their behavior to take math. Are they worth it? Will they work? Realistically, what can a school do to effectively market math classes to male and female students?

Marketing is the coordinated system of activities involved in the moving of goods and services from the producer to the customer. It includes the development of the product, the pricing, packaging, and carefully defined promotional campaign. Here the product is effective math instruction, and the marketing strategy will be a planned course of action toward bringing an increased number of female students into math classes.

The Key to Marketing

Marketing involves bringing the right product, at the right price, in the right place, with the right promotion, done by the right people, to the right target audience. The time you take to define each of these aspects of your marketing campaign will help you focus your energies and resources toward getting the right message to the right people.

First define your **product.** Is it all math courses? Do you want to focus particularly on the first course students can elect? Do you want to generate excitement for a course just before that first choice?

Can you vouch for the **quality** of that product? Is it **geared** toward the **market** you intend? The article on p. 8 will tell you more about how to create math classes that are more responsive to girls' learning needs. But just changing your product will not automatically bring your new students in.

Your choice of specific courses to market will start to define your possible audience. Is it large enough that changing only a portion of the group will make a difference? Is it too large to have a unified message? Is that group reachable by you or someone you hire? Is there at least a chance they will be responsive? Marketing physics or advanced math classes to girls may not be worth your effort if you had only a few girls in the prerequisite courses. But marketing math in general may confuse you in trying to reach twelve year olds and eighteen olds with the same message. Your market should be of manageable size to the resources of your campaign, and your product should be specific to that market. Find out as much as you can about who they are, what they like, what they think of your product, and why they haven't wanted it in the past. The research on girls and math should help you signficantly with this aspect of your work.

Price

We often don't think of free, public education as having a price, but it does. Will students get adequate credit for the time they put in? Will the course conflict with something else they may want to take? What kind of pressure will they have to take from peers or family? How might it affect their self image? Their after school job? Have a clear idea of what the student's cost may be. If possible reduce those costs through rescheduling, support groups, peer and family education. But also include in your message that quality products are often expensive, though worth the added price. Address the price issue directly in your marketing campaign.

Place

The physical locale for your classes is also important. See that it is in an attractive area and that students are made aware of that Remember kindergarten trips to first grade, or free lessons to get you to visit the health spa? The room itself should have motivating materials and attractive posters of people of both sexes. A class at the remote end of the building, a location where students of only one sex congregate, a traffic pattern that may expose students to sexual harassment can discourage enrollment. Course fairs and orientation meetings should be in pleasant surround-

ings and should show people the attractiveness of the actual classroom to be used. Locale can often signal a school's commitment, or lack of real commitment to equity.

Your choice of **promotion medium** may well be the biggest decision you have to make. Given your audience and your product, what will work best? Word of mouth? Posters? Fliers? Assembly programs? Radio? Frisbees? Hats? Bookcovers? Shoelaces? Banners? Marketing researchers specialize in defining effective media for different segments of the population. Advertising companies have lists of promotional items. Get an advisory group together and ask them what will sway your group. Teenage girls are often fond of music, posters and clothing related items, so try using them to convey your message, or draw them as symbols in your campaign. Your medium should closely fit your message. It can be serious and enduring (invest in your future), playing on students' uncertainty (keep your options open) stressing the interactional (math is a team sport), intrinsic interest of math (a geometric puzzle as logo), heightened esteem of good math students, or the status of being nontraditional. Make sure your audience will believe your message and that you convey it clearly. Have recognizable graphics and repeat your message frequently.

Who delivers your message is also very important, for that person conveys the value of your program. Your spokesperson should be knowledgeable, friendly and confidence-inspiring to your audience. Teenagers report they are swayed most by peers in their course choices, then by parents and other adults they know well. Teachers are decidedly less influential, and counselors have the least influence of all. Letting well-regarded students talk about their own experiences may be one of the most powerful marketing devices. Remember to pick students a little older than your target group, from both sexes and different racial and ethnic backgrounds. Encourage your message givers to be realistic about what they found difficult, who helped them, and what kept them going, as well as letting them relate their enthusiasm for math, the career they're embarking on, the salary they make, or the independence they feel. If you choose older role models, make sure students find them attractive, "normal" people with whom they could share mutual interests. Be continually aware of many students' fear of becoming the crazy scientist or the homely brain.

Role model panels, course fairs, class visits, prizes, giveaways, course catalogues, contests, social events, and support groups and clubs are all possible marketing devices. Make sure to take advantage of the all-important influence of word-of-mouth. Many of these promotional activities have existed in schools for years, but they've been targeted at a white male audience. Now it's time to rethink them and target them more equitably. Set yourself a modest goal for the first year, then refine your campaign as you become more knowledgeable in what works. Create an event, a tradition, and eventually an institution. Broaden your horizons and those of your students. Market math!

-- **Eleanor Linn**

Continued from cover:

This publication identifies skill areas and learning styles that especially help females, but will encourage all students in mathematics. It gives practical suggestions for administrators, teachers, and counselors about what they can do to help foster sex equity in mathematics. It also contains an assessment instrument and bibliography. A more extensive resource manual on this topic is available from our office.

Recent provisions of the Carl Perkins Vocational Education Act set aside special funds for the encouragement of students in programs nontraditional for their sex. Recent math/science legislation also points to the need for improvement in the instruction of mathematics. Information in this newsletter can be used to implement quality programs that will increase student participation, motiviation and achievement in mathematics.

Instructional Strategies for Fostering Girls in Math

In the 13 years since Lucy Sells made the vital connection between sex segregation in the labor force and female students' avoidance of mathematics courses, a number of gifted educators have worked successfully on translating gender and math research results into positive instructional practices and useful teaching materials for elementary and secondary schools. They are designed to counterbalance the forces that influence many young women to discontinue their math studies. Many of them apply elements from recent research on effective instruction and new feminist work on the psychology of women. Their main goals are to foster teacher and student **awareness** of math equity issues, to foster a **climate** in which both females and males learn math skills effectively, to allocate adequate teaching time to the **skill areas** in which each gender has most difficulty, and to provide concrete examples of the **usefulness** of math in future career choices.

Awareness Activities

Gathering and analyzing high school math enrollment information can raise student and teacher awareness of equity issues. So can essays written by students about what they plan to do when they are thirty years old. Their aspirations can be graphed by career area and gender.

Patterns then can be discussed, myths raised and dispelled. Information about why students say they drop math, about how necessary math is for career choices and earning potential, about similarities in male and female math ability in the early grades, and awareness of the influence of past discrimination practices should be presented to students regularly with the goal of creating awareness and conveying the message that they can prepare themselves for a future with more options.

Facts about labor force participation and earning differentials are also influential to students, teachers, and parents.

Instructional Climate

This is probably the single most important area on which to focus attention, as it is often students' attitude toward math rather than their lack of ability that leads to their math avoidance. Many students report that math class is a more rigid and competitive environment than, say, English or Social Studies. True math has its right and wrong answers, but there can be many correct ways to solve a problem, or to find an error in reasoning. Acceptance of **multiple strategies,** emphasis on the **process,** and encouragement of **risk taking** in problem solving are ideal ways of fostering a climate that is more conducive to learning.

Here are some ways to help encourage risk-taking and confidence in problem solving.

Stations are problems placed around the classroom, which students may try at their own pace, often with a partner. They may be left up for several days or weeks to introduce or reinforce a concept, to foster discussion of different problem solving strategies that can be used with them, to help build student vocabulary for talking and thinking about math, and to build intrinsic motivation in math-related activities. They are extremely effective in providing a non-threatening environment for risk taking in problem-solving and should be given their due importance by allotting class-time for them at least once a week.

Cooperative activities use problems that cannot be solved individually, but need the participation of 3-5 students working together. Groups are far more productive than individuals, and this type of problem solving models the interactions actually used in industry and the scientific community. Student achievement particularly in problem solving ability increases considerably with cooperative activities, especially when students are taught peer tutoring behaviors and when they are graded as a group, with a score based on the improvement of all members.

Motivational introductions to lessons are often aimed at getting the attention of the most disruptive students, who are usually

male. Introductions that refer to male-oriented sports, emphasize elements of danger, or challenge students to defy the teacher's assertions decrease female involvement in the subsequent lesson. References to popular music, learning to drive, planets, fossils, making things grow are of interest to students of both sexes. Sex-fair classes should use sex neutral topics in motivational introductions.

Manipulatives are helpful at all levels of instruction. Drawing pictures, moving things around, simplifying, estimating with actual objects all help make mathematical concepts more concrete. Ideally older students should be able to move to abstract levels of thinking, but manipulation can help them understand new concepts or break down difficult problems into understandable components. As with any equipment, manipulatives need to be introduced slowly, with rules for proper use and respect. A sheet of paper which serves as storage area for brightly spray-painted lima beans can help eliminate a classroom mess.

Equal distribution of praise and special help is also of great importance. Male students tend to receive both more praise and more criticism than females, white males receiving up to three times more teacher interaction than Black females. This trend exists in many classrooms, but is particularly prevalent in math classes, where female students often interpret a lack of teacher attention as indicating their lack of ability in the subject area. Programs like TESA (Teacher Expectation and Student Achievement) and GESA (Gender Expectation and Student Achievement) help teachers monitor each other on the praise, rewards, criticism, and individual help that students in their classes receive.

Textbook bias is somewhat less of a problem in newer editions than in the past, but many word problems still have men building things and women forgetting things. Point out to students the harm that is done to girls and boys in perpetuating such stereotypes and making girls feel unwelcome in math. Rewrite or have students rewrite problems using the same concepts but different character attributions. Look at pictures and switch them around. You need not spend much time on this aspect of instruction, but you will get the message across to all students that girls are considered serious students in your class.

Sexual harassment and **powerplays** between students must also be checked. Students who control use of equipment, deface projects, introduce timed competition, or make remarks on student ability are not adding humor or motivation to a classroom. They make the climate decidedly less comfortable for other students, whose reaction is often to retreat or blame themselves for the disturbance.

Calling students to the board, singling them out in front of their peers, or repeated questioning are other behaviors that are particularly uncomfortable for many adolescent girls, unsure of their physical appearance, their right to attract attention and acknowledge a sense of ambition.

Curriculum Content

Standardized achievement tests and research measures show little difference in female and male mathematical knowledge, skills, and understanding until the high school years, when fewer girls are enrolled in math classes. Slight differences exist in spatial relations, estimation, and probability and statistics skills. More sizeable differences exist in solving multi-step word problems and understanding applications of mathematical concepts. An equitable math class needs to emphasize those areas of the curriculum where girls and boys have more difficulty.

The traditional curriculum spends most of its time on accurate calculation. Males and females acquire these skills fairly equally, with females having a slight advantage in the lower grades. Considerably less time is spent on the areas in which girls have more difficulty. Look at how much time you spend on each of those areas. How many pages of your textbook are devoted to them? Boys may gain skills in these areas outside of school in the type of play activities and projects they are more likely to do with family members. Girls are more school dependent for learning them.

Spatial relations are an important part of all kinds of problem solving: visualizing simple arithmetic concepts, understanding geometry, using tools, building and fixing things. Spatial relations should be a major part of the early childhood curriculum and should continue throughout the math sequence. Manipulatives and cooperative work are the best methods for teaching them.

Estimation and measurement are also best taught through hands-on activities, and should get more attention in a sex-fair curriculum. A student's ability to estimate is a key factor in her/his confidence.

Multi-step word problem solving skills and applications ability grow directly out of students' confidence. Only with a vocabulary for discussing math concepts, a variety of problem solving strategies, and an ability to assess probable right and wrong answers, can students have the framework for solving complex problems. Using stories with mathematical themes is an excellent way to build application skills. Programs that encourage mathematical reasoning in other content areas are also valuable. Social studies classes can be encouraged to collect, organize and interprete statistical data, English classes can read and write mystery-type problem solving stories.

Usefulness of Math Role Models

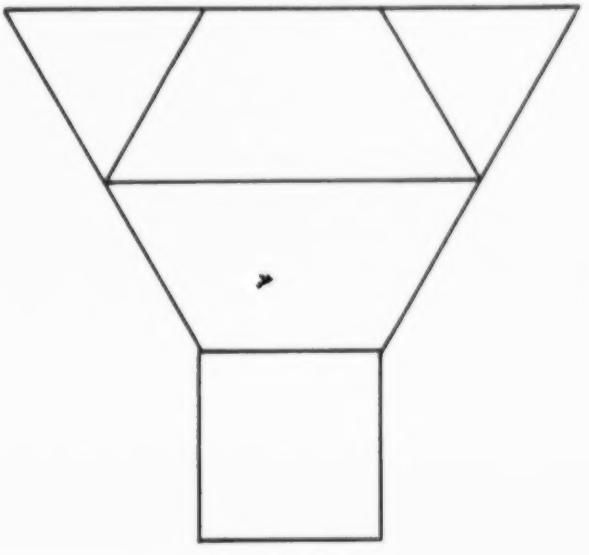
Many young women claim to drop math and science classes because they see no use for them. This attitude often stems from a lack of understanding that they will work in their adult lives, that they don't know how much math is needed for many jobs, that they have not been exposed to traditional and nontraditional career options, that they are unaware of the pay advantages in technical and scientific fields. Many students feel they have no control over their future worklives.

The schools most successful in fostering girls in math and science build career components into their math and science classes. Teachers provide information about traditional and nontraditional fields, the amount of math needed for specific jobs, the skills used in different jobs, the salaries in the workforce and how specific skill areas relate to jobs. Most effective is the use of role models, inviting nontraditional young workers of both sexes to talk to students about their work. They can provide the most accurate information about their training, the skills they use, and the salary they receive. Students react particularly well to workers' accounts of who helped encourage them, how they did in school (they were usually not straight-A students), and how they lead regular lives outside of work. Younger students especially enjoy learning to use a specialized tool or piece of equipment used by a nontraditional worker.

Many strategies are available to us to help encourage all students in the study of math. Which ones are you using?

--Eleanor Linn

PUZZLE



Tetrahedron Pieces
(need 2)

ESTABLISHING SUPPORT GROUPS FOR GIRLS IN MATH, SCIENCE AND COMPUTERS

This newsletter has already mentioned that the above three areas are considered nontraditional areas of study for girls. Survival of people joining an area which is not theirs by tradition is made easier if there is a support group, study group, or special club. Such a group can also be used as an effective strategy for the recruitment of new members as has been shown in numerous projects in vocational education. This article will address itself to some of the steps that should be followed by an equity advocate within the schools in establishing a support group for nontraditional students: specifically, for girls enrolled in advanced math, science, and computers.

Step 1: Consult with and get the support of your administrator, teachers, and counsellors. Write to them, talk to them personally and have them come to the first meeting of the formation of the support group. Always talk about how all groups that want to bring about change in individual behavior and attitude use the strategy of support groups. You can cite examples from vocational education, Alcoholics Anonymous and drug rehabilitation programs, and college programs to help older returning students.

As for rationale, be sure to say that such a group will be cost effective by giving more time to the school counsellor to deal with other students and other matters. Make sure that the people you are talking with do not misunderstand this to mean that it will replace individual counselling. It is cost effective because problems arising from being a nontraditional student will be addressed in a group format rather than one on one.

At this stage in the process focus primarily on alleviating the fear and anxiety of teachers and counsellors. Let them know that you are on their side. All you are trying to do is make their job easier by spotting trouble before it becomes explosive. Show them that the support group is there to help facilitate a smoother transition.

Step 2: Invite administrators, teachers, counselors, and others to a planning meeting. Give feedback of this meeting and information about follow-up to all those who came, as well as those who did not. This will show both groups that you are serious about this endeavor and that it is going to materialize.

Step 3: If possible, announce the first support group meeting before recruitment and/or course selection is complete. Have a brochure ready that can be given to students at this time. Give copies of this brochure to teachers, counsellors, recruiting and admission officers. Students who select a nontraditional course of study feel more comfortable if they know beforehand that there are other students like them.

Step 4: Once you have the names of your nontraditional students, contact them by letter a few weeks before school begins. In this letter mention the fact that they are to be admired for signing up for these courses. Suggest that the group or club will help them even more. Mention the date and time of the first meeting, where it is going to be, and who to contact. Give your name, office number and times when you can be reached. If there is time and money, call them a few days before school begins as a follow-up and reminder.

Step 5: As much as possible, make sure that group facilitators are of different race and ethnicity. If you have nontraditional students of both genders, try to have a facilitator of each sex.

Step 6: Schedule the first meeting for the first week that school begins. Take into special consideration the period of allowable course changes. This is when nontraditional students are most vulnerable. During this time, post notices for meetings in all visible places. Insert them in newspapers, ask teachers, counsellors and others to make announcements of meetings.

Step 7: Begin the first meeting with a pep talk about students' courage and commitment to select nontraditional areas of study. Mention to them that they may not feel comfortable with all teachers and fellow students but that the support group will help them deal

with these issues. Tell the students that they should be prepared to do all their work but that the group may help them study better. You should also make sure the students know that the support group will not change rules and requirements unless it is established that such rules and requirements are sex-biased. Mention that the support group can mediate with teachers, administrators, counsellors and students about their biased behavior and, among other things, may be able to arrange for tutorial help.

Step 8: Close the session with another pep talk and announce the location and time of the next meeting. Schedule this meeting for at least two weeks after the first meeting. Instruct the students to come with some issues and problems to discuss. These could be what has happened to them within those two weeks or what they think will happen. Make sure that the students understand that if they encounter any difficulties before the scheduled meeting that they can contact you or any of the other facilitators. Also mention that at other sessions speakers will be available who have dealt with the same issues themselves. They could be working in math, science, or computers, or any other nontraditional area. This is especially helpful at sessions when students do not have much to say.

Step 9: As a facilitator, go back to the administrators and tell them how the group is going. Show them how helpful it is. Consider inviting them as speakers. You could also consider inviting other teachers, counsellors, or students.

Step 10: Evaluate the program by asking students how the support group is helping them, and by keeping enrollment and drop-out data. You will need specific documentation to win approval for continuing and expanding the support program, and to recruit new students. Start collecting it from the beginning.

Step 11: If the number of girls in math, science, and computers is not enough to form a support group, have the girls enrolled for these courses join another support group formed for nontraditional students. Hopefully, there are students in other nontraditional areas. BUT HAVE A SUPPORT GROUP one way or another.

-- Salome Gebre-Egziabher

What Administrators Can Do to Foster Girls in Math

Effective schools research points most decidedly to the principal's crucial role in promoting student achievement. The principal, department chair, or curriculum coordinator who leads a sex equity effort in mathematics will:

- Have a basic understanding of the instructional strategies that foster girls in mathematics.
- Promote awareness by gathering and disseminating enrollment information in a secondary school, and standardized test score item analyses by problem type and gender.
- Make time and resources available for awareness-building activities for teachers, counselors, parents and students.
- Support staff development in math equity to help promote equitable teaching strategies and curriculum.
- Allocate budget for manipulatives, and other problem solving educational materials.
- Support staff development for other subject teachers who suffer from math avoidance, to help them promote math related activities and positive attitudes in their classrooms.
- Ensure that award criteria, club strategies and other forms of mathematics recognition are consistent with the principles of an equitable climate.
- Include equitable teaching strategies in teacher and administrator evaluation and accountability.
- Support the formation of networks for students and teachers to help foster girls in math and science.

Do You Encourage All Students to Remain in Math and Science ?

This checklist has been developed to assist school districts in assessing their math/science enrollment in terms of gender fairness. The checklist is not intended to be a comprehensive tool, but rather a "quick assessment" of the district's response to the needs of all students.

After reading each question, decide upon the answer that most closely represents the situation in your school district. Determine your total score and then turn to page 15 to see both how your district rates and where you might start planning change.

1. **Do enrollments in all programs and classes reflect the male-female balance and cultural diversity found in the district?**
   - 5 points — if you have a written procedure that is used yearly for auditing course enrollment data for disproportionate enrollment, particularly in courses where enrollment tends to be disproportionately of one sex or the other, and the procedure contains specific guidelines and activities that are in progress to combat disproportionate course enrollment.
   - 3 points — if you have examined course enrollment data for disproportionate enrollment of males or females at least once in the past five years, and have begun working on activities to combat this.
   - 1 point — if your staff is justifying differential course enrollment by using sex-biased arguments such as: "employment opportunities in any occupation or profession are more limited for members of one sex than for members of the other".

2. **Are your career information services being delivered in gender affirmative ways?**
   - 5 points — if your career resource center has traditional and nontraditional illustrations in displayed and catalogued materials, if publicity about career speakers is distributed to all students without regard to gender, and career role model speakers are a mixture of traditional and nontraditional and evenly balanced by gender.
   - 3 points — if you are looking for more unbiased material, occasionally have been able to find a nontraditional speaker, and try to keep as much bias out of materials as possible using biased materials, when necessary, in unbiased ways.
   - 1 point — if you have catalog or display headings such as "Careers for Men/Careers for Women" or use materials that are sex-stereotyped.

3. **Have inservice programs on non-sexist approaches to course selection and career counseling been provided for the entire counseling staff?**
   - 5 points — if inservice programs have been implemented in which the entire counseling staff has consciously worked to understand their own frame of reference and how it affects their behaviors, language, interactions, judgments and expectations and identified and developed plans to overcome sex bias in the counseling program.
   - 3 points — if you have had at least one speaker make a presentation on this topic to most of the counseling staff, and the staff has developed some ideas that they might use to increase students' options in course enrollment.
   - 1 point — if no workshop has been conducted for the counseling staff, or if they are still making fun of the last person who suggested that one be held.

4. **Have you disseminated information to administrators, teachers, counselors, parents, students, and community members on future employment trends, average salaries, pre-requisite training needed, and level of gender and racial participation in selected employment areas?**
   - 5 points — if there are systematic and regularly scheduled attempts to provide the constituent groups listed above with up-to-date information on these topics.

3 points if you have tried this at least once, even if you just copied material you were given.

1 point if you have not given this information to the constituent groups listed above.

5. **Have inservice programs on non-sexist approaches to teaching been provided for the entire teaching staff?**

5 points if inservice programs have been provided in which the entire teaching staff has consciously worked to understand and monitor their own frame of reference and how it affects their behaviors, language, interactions, judgments and expectations.

3 points if you have had at least one speaker make a presentation on this topic to most of the teaching staff and the staff has developed some ideas that they might use to monitor the equity of their behaviors and expectations.

1 point if no workshop has been provided for the teaching staff or if they are still making fun of the last person who suggested having one.

6. **Have inservice programs on gender affirmative strategies for teaching math and science been provided to all administrative and teaching staff in these subject areas?**

5 points if inservice programs and faculty support groups regularly share successful cooperative learning strategies, gender fair motivational techniques, risk-taking, estimation, spatial relations, and multi-step problem solving skills.

3 points if an initial inservice workshop introduced these ideas, but they have not been followed up and used frequently.

1 point if no such workshop has been held or if you believe that the curriculum and the textbook are synonymous.

7. **Do you offer extra assistance and encouragement to students in mathematics through remedial programs, peer and community tutoring programs, family involvement programs, resource rooms and other special services?**

5 points if your math assistance services include all of the above programs and they are comparable in funding and effort to your special assistance programs for reading.

3 points if you have a few math assistance programs, but they are not nearly as developed or well funded as your reading assistance programs.

1 point if you only provide tutorial services to students who request them and advise girls to choose other electives rather than lower level math classes.

8. **Has your staff organized support groups, clubs or study groups to encourage students who are participating in courses that are nontraditional for their gender?**

5 points if you have at least one support group that is meeting regularly to accomplish this goal, and this group is discussing such topics as sexual harassment and traditional and nontraditional gender based expectations.

3 points if you have held at least one group meeting for nontraditional students, or if you have discussed these topics with students individually.

1 point if you believe that opening courses to all students is all you can do to encourage nontraditional enrollment.

9. **Is the information given to teachers, parents, and students about course choice selection directly related to overcoming gender bias and stereotyping?**

5 points if administrators, teachers, counselors, and equity specialists have worked together to design sex affirmative course choice materials, parent and student information programs, and marketing plans.

3 points if career information is disseminated before course choices are made, but attempts to link the information and choices is done on an individual basis.

1 point if the course choice process depends mostly on parents' and students' outside knowledge and possible gender and racial bias.

10. **Does your program encourage the continued participation of pregnant students, or students who are parents in upper level classes, particularly math and science?**

5 points if pregnant students and students who are parents are encouraged to stay in their regular classes with the same schedule that they would ordinarily follow. Counseling and support groups are made available to these students.

3 points if pregnant students stay home and get homebound instruction or a separate program that has no upper level math/science classes.

1 point if pregnant students and students who are parents are encouraged (either overtly or covertly) to stop attending school.

SCORING THE CHECKLIST

38 - 50 points Congratulations. You are making a strong effort to eliminate sex bias in math and science. Although you are generally moving in the right direction, there are probably a few areas that you should examine and plan to remedy. Use the groundwork you've already established to increase your efforts.

25 - 37 points Although you have some distance to go to achieve gender balanced enrollment in math and science, you probably have developed some awareness of the issues. This is an important first step, that you can build upon successfully.

13 - 24 points If your district has not already initiated efforts to develop a comprehensive plan for gender balanced enrollment, consider doing so at this time. Begin by forming a planning committee which is representative of all major groups within the district, and charge the committee with developing specific time-oriented goals for the completion of this project.

0 - 12 points It is necessary for your district to begin examining this issue as an area of concern, and to assess basic levels of awareness. It would be advisable to begin with a strong statement of intent, and to develop staff awareness of the problem. Set a specific goal for completion of the first phase of the effort. Consider obtaining some support or assistance from an outside agency such as CSES.

-- Marta Larson

Adapted from:

Andersen, Tom and Barta, Sheryl. **Multicultural Nonsexist Education in Iowa Schools: Mathematics and Science.** Des Moines: Educational Equity Section, Iowa Department of Public Instruction, 1981.

Barta, Sheryl and Andersen, Tom. **Multicultural Nonsexist Education in Iowa Schools: Guidance and Counseling.** Des Moines: Educational Equity Section, Iowa Department of Public Instruction, 1983.

Vergon, Charles B. **Title IX Self-Evaluation Guide for Elementary and Secondary School Districts.** Ann Arbor, Michigan: Program for Educational Opportunity, University of Michigan School of Education.

Wisconsin Department of Public Instruction **Freedom For Individual Development: Counseling and Guidance.** Washington DC: U.S. Office of Education, Women's Educational Equity Act Program, 1977.

Other references are in the bibliography on p. 16.

Recommended Resources on Girls and Math

Research

Armstrong, J. M. "Achievement and Participation of Women in Mathmatics," **Journal for Research in Mathematics Education** 12 (1981): 356-372.

Eccles-Parsons, J., et al. "Attributions and Academic Choice: Origins and Change," in **NIE Annual Report.** Washington, D.C.: National Institute of Education, 1979.

Eccles-Parsons, J., et al. "Socialization of Achievement Attitudes and Beliefs: Classroom Influences",**Child Development** 53 (1982): 322-354.

Eccles-Parsons, J., et al. " Socialization of Achievement Attitudes and Beliefs: Parental Influences," **Child Development** 53 (1982): 310-321.

Fennema, E., and Sherman, J. "Sex-related Differences in Mathematics Achievement, Spatial Visualization and Affective Factors," **American Educational Research Journal** 14 (1977): 51-71.

Fox, L. S. "The Effects of Sex Role Socialization on Mathematics Participation and Achievement," **Women and Mathematics: Research Perspectives for Change,** NIE Papers in Education and Work. No. 8. Washington D.C.: National Institute of Education, 1977.

Jacobs J. and Eccles-Parsons, J. "Science and the Media: Benbow and Stanley Revisited," University of Michigan, 1983 (report).

Kahle, J. B. "The Disadvantaged Majority: Science Education for Women," Burlington, N.C.: (Carolina Biological Supply Company), 1983.

Maccoby, E. and Jacklin, C. **The Psychology of Sex Differences.** Stanford: Stanford University Press, 1974.

Pedro, J.P., Wolleat, P., Fennema, E., and Becker, A.D. "Election of High School Mathematics by Female and Males: Attributions and Attitudes," **American Educational Research Journal** 18 (1981): 207-218.

Trowbridge, L. W., et al. **Becoming a Secondary School Teacher.** Columbus, OH: Charles E. Merrill, 1981.

Vockell, E. L. and Locbonc, S. "Sex-Role Stereotyping by High School Females in Science," **Journal of Research in Science Teaching** 18 (1981): 209-219.

Curriculum Materials

Burns, Marilyn. **Math for Smarty Pants.** Palo Alto: Creative Publications. Grades 4-8. $6.95. Stories, activities, problem solving in this book and several others in this series.

Downie, D., Slesnick, T., and Stenmark, J. **Math for Girls and Other Problem Solvers.** University of California-Berkeley: 1981. Elementary school level curriculum activities. Emphasis on problem solving activities: logic and patterns; breaking set; creative thinking, estimating, and observing; and spatial visualization. $7.50. Order from EQUALS. See Organizational Resources.

Fraser, Sherry, et al. **SPACES: Solving Problems of Access to Careers in Engineering and Science.** Palo Alto, CA: Dale Seymour Publications, 1982. Activities for students in grades 4-10, about scientific careers; problem solving skills; attitudes toward math; spatial visualization skills; and work with mechanical tools. $10.00. Order from EQUALS. See Organizational Resources.

How High the Sky? How Far the Moon? An Educational Program for Girls and Women in Math and Science. Newton, MA: WEEA Publishing Center, 1982. Short exercises for K-12 students on problem solving skills and career information. $14.50. Order from WEEA. See Organizational Resources.

Science Career Programs. Research Triangle Park, NC: Research Triangle Institute. 1982. National Science Foundation sponsored program to encourage females and minorities in grades 4-9. Information about skills, careers, salaries in format useable with students. Accompanying filmstrip and poster set.

For Educators

Beane, Diana Banks. **Mathematics and Science: Critical Filters for the Future of Minority Students.** Washington, D.C.: MidAtlantic Center for Race Equity, 1985.

Brush, Lorelei R. **Encouraging Girls in Mathematics: The Problem and the Solution.** Cambridge, MA: Abt Books, 1980. Summary of research and major recommendations for change.

Cheek, Helen Neely, et al. **Handbook for Conducting Equity Activities on Mathematics Education.** Washington, D.C.: National Council of Teachers of Mathematics, 1984.

Expanding Your Horizons in Science and Mathematics: A Handbook for Planners. Newton, MA: WEEA Publishing Center, 1980. Describes how to plan, conduct, and evaluate conferences to increase young women's interest in mathematics and science. Order from WEEA.

Fennema, Elizabeth, et al. **Multiplying Options and Subtracting Bias.** Reston, VA: National Council of Teachers of Mathematics, 1981. Materials for developing and presenting workshops on women and mathematics to junior and senior high school students, school counselors, parents and science and mathematics teachers. Four versions of a videotape of the same title.

Kaseberg, A., Kreinberg, N., and Downie, D. **Use EQUALS to Promote the Participation of Women in Mathematics.** University of California-Berkeley: 1980. Describes the EQUALS Teacher Education Program, designed to promote sex-fair mathematics instruction and counseling. Provides methods, and materials for K-12 use, bibliographies.

Tobias, Shelia. **Overcoming Math Anxiety.** Boston: Houghton Mifflin Co., 1978. A modern classic, particularly helpful in assisting teachers to recognize their own math avoidance, and how they may convey messages about it to their students.

Mostly for Families.

Skolnick, J., et al. **How to Encourage Girls in Math and Science: Strategies for Parents and Educators.** Englewood Cliffs, NJ: Prentice-Hall, 1982.

Thompson, Virginia, et al. **Family Math.** Berkeley, CA: To be published 1986. Strategies for workshops for parents and children together. $15.00 plus $1.00 shipping from EQUALS.

Organizational Resources

American Association for the Advancement of Science (AAAS)
Office of Opportunities in Science
1776 Massachusetts Avenue, NW
Washington, D.C. 20036
(202) 467-5438
Monthly magazine **Manpower Comments,** sponsors conferences and numerous other publications.

EQUALS
Lawrence Hall of Science
University of California
Berkeley, CA 94720
(415) 642-1823

Curriculum materials, workshops for teachers and parents. Dissemination sites in the Midwest:

EQUALS, CSES
1046 School of Education Building
University of Michigan
Ann Arbor, MI 48109
(313) 763-9910
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(317) 285-5477
Charles Payne, Director

Minnesota EQUALS, Teacher Center UMN
110 Pattee Hall
University of Minnesota
Minneapolis, MN 55455
(612) 376-5297
Carol Johnson, Director

EQUALS, Cleveland State
College of Education
1983 E. 24th St.
Cleveland, OH 44115
(216) 687-4534
Diane Stupay, Director

Girls and Science and Technology (GASAT)
U.S. Contact, Dr. Cinda Sue Davis
Women in Science, 350 S. Thayer St.
University of Michigan
Ann Arbor, MI 48109
(313) 763-7225
International organization, sponsors periodic conferences, next one to be held in U.S.

Math/Science Network
Mills College
Oakland, CA 94613
(415) 635-5074
Numerous publications on equity, maintains national listing of Expanding Your Horizons conferences.

National Council of Teachers of Mathematics
1906 Association Drive
Reston, VA 22091
(703) 620-9840
Position statement on the education of girls and young women, resource manuals, handbooks, and regional conferences.

Women and Mathematics
Mathematical Association of America
National Director, Dr. Carole LaCampagne
Dept. of Mathematics
University of Michigan-Flint
Flint, MI 48502
Regional Midwest chapters in Central Ohio, Chicago, and Michigan. Provides secondary school lecture program. Request forms available.

Women's Educational Equity Act Publications (WEEA)
Education Development Center
55 Chapel St.
Newton, MA 02160
(800) 225-3088
Curriculum materials, model workshop guides, audiovisual materials.

Women and Mathematics Education (WME)
George Mason University
4400 University Drive
Fairfax, VA 22030
(703) 343-2421
Dr. Judith Jacobs
Resource lists, packets, rental of **Multiplying Options and Subtracting Bias** videotapes and workshop manuals.

Role Model Videotapes

Nothing But Options. Oakland, California: Math/Science Resource Center, 1984. Environmental scientist; systems analyst; electrical engineer; financial investment counselor, and computer graphics designer. Upbeat presentation. Could be used with junior high, high school, or adult audiences. 17-1/2 minutes. $40 rental, $240 purchase.

Math/Science Resource Center
Mills College
Oakland, CA 94613
(415) 430-2230.

Options Unlimited: Women in Technology Videotapes. Consortium for Educational Equity. Rutgers University, New Brunswick, NJ. (201) 932-2071. Two half-hour videotapes each featuring five women in rewarding careers.

Sandra, Zella, Dee, and Claire: Four Women in Science. A film for students in grades 7-12, exploring the work and lives of an astronomer, a mechanical engineer, a veterinarian, and a laser physicist. Available with **Expanding Your Horizons** book, WEEA Publishing Center.

Science: Women's Work. National Science Foundation, 1982. Half hour 16mm sound and color film. Geologist, astronomer,

Continued on page 20

PUBLICATIONS AVAILABLE

The following materials are still available in limited quantities. If you would like to request a copy, please write to:

Publications, CSES
SEB 1046
University of Michigan
Ann Arbor, MI 48109-1259
(313) 763-9910

Breakthrough issue on Effective Schools

CSES Drama Bank A collection of materials and activities utilizing drama to convey equity issues.

Handbook of Activities to Combat Sexism in Education

"Remember the Ladies" A Handbook of Women in American History

Women's History Week Lesson Plans, 1983

Title IX Line issue on Comparable Worth

Title IX Line issue on Public Policy

Title IX Line issue on Sex Equity in England and Wales

Title IX Line issue on Sexual Harassment

Title IX Line issue on Vocational Education

Title IX Line issue on Women in Administration

Title IX Line issue on Women's History, Women and Work

Title IX Line issue on Women and Sports

Title IX Line issue on Women in Literature: Historical Images of Work

Who's Hurt and Who's Liable: A Curriculum Guide for School Personnel on Sexual Harassment

Women, Math, and Science: A Resource Manual

Permission may also be requested to reprint selected materials.

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Please send to: **Mailing List**
CSES, SEB 1046
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School of Education
Ann Arbor, Michigan 48109-1259

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marine biologist, and other women interviewed. Free from:

Modern Talking Picture Service
21421 Hilltop St. #23
Southfield, MI
(313) 352-2780

Women in Science. School of Dentistry, University of Michigan, 1983. Series of videotapes mostly for high school students, available in several formats for purchase or rental. Includes videotapes on women in dentistry, engineering, chemistry, computer science, geology, biomedical science, physics/astronomy, and the dilemina of deciding what to do. Available from:

Women in Science
B322, School of Dentistry
University of Michigan
Ann Arbor, MI 48109
(313) 763-3337

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Sources from page 12

Implementation Guides: Practical Strategies for Achieving Sex Equity Using Support Group to Retain Nontraditional Vocational Students. Wayne, MI: Wayne County Intermediate School District, n.d.

The Rewarding Challenge: Welcoming Re-Entry Women Students to the Small College. Midland Lutheran College. Fremont, NE: WEEA Publishing Center, 1985.

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